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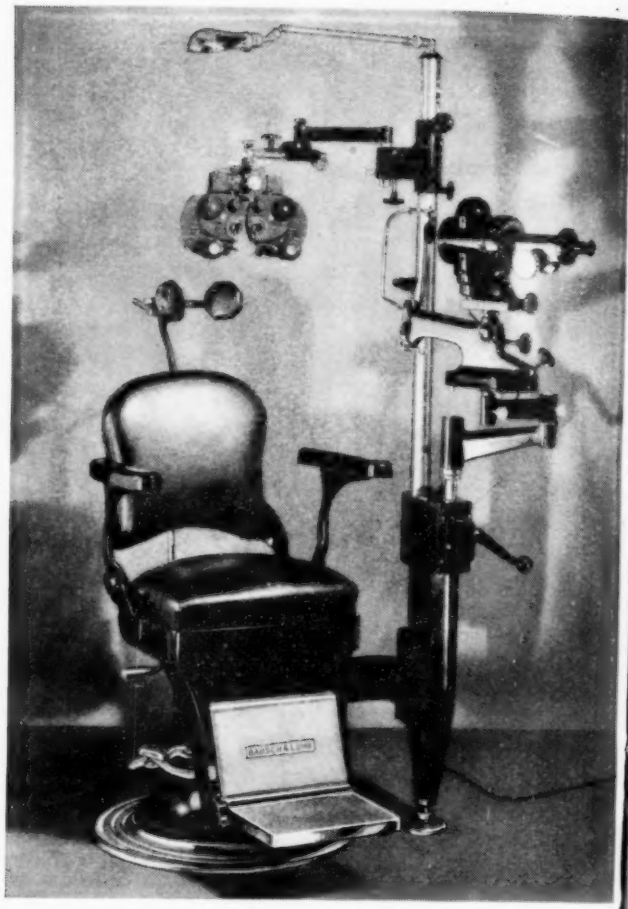

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AMERICAN JOURNAL OF OPTOMETRY

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THE PLACE OF CRITICAL EVALUATION OF PUBLISHED WORK IN THE PROGRESS OF OPTOMETRY*

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Optometry differs from fields of social science in several aspects. Its basic assumptions are rooted in accurate scientific knowledge. Its instruments and techniques enable us to measure things of substance although somewhat subjectively as yet. Finally, it is not yet burdened with a volume of literature based upon uncontrolled experience and observations, embellished with mathematical and statistical refinements, and often leading to several different and opposing conclusions at the same time. We may say, therefore, that it has more of the characteristics of a true science than otherwise. However, unless the optometrist makes research methods a part of his everyday experience, there is danger that optometry will follow the same path leading to uncertain conclusions without experimental foundation. For in our optical journals and other periodicals which report the results of experience, there appears much published work based upon uncontrolled observation, poor technique, non-experimental methods of collecting and recording findings, and the like. On the other hand, the knowledge of research methods, and the application of methods of critical evaluation, should enable the optometrist to weed out and discard unreliable results as they appear.

The necessity that practicing optometrists have a knowledge of research studies and methods has been pointed out in a previous article.[1] Not only does it enable them to apply techniques and instruments more intelligently, and to interpret the results according to the significance of the original study, but it also equips them for a scientific approach to, and working out of, challenging problems which arise in clinical practice. Some of the basic meanings and definitions of elements involved in research were presented. What is research? A hypothesis? A problem for research? How does one approach a problem to obtain an adequate solution? These were discussed among other things. However, if the

*Submitted for publication Sept. 8, 1938.
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[1] B. L. Spanier, "Some Meanings and Definitions in Research for Optometrists," *Amer. Jour. of Optometry* (Editorial), October, 1938.

optometrist is to aid in the movement toward better professional standing, he should have a more specific knowledge of research factors. In addition to this, he needs to know how to critically evaluate present work in the field of optometry.

This article presents some factors designed to aid in more critical evaluation of present published work. For instance, the material may be classified as major research, minor research, discussion, case studies, library study, etc., depending upon the control of experimental factors. number of cases, methods of collecting material, type of material collected, and the like. After classification, a critical analysis in the light of the following criteria should give deeper insight into what constitutes good research, what contributes to present knowledge, and what is a "rehash" of previous known material with no purpose in view but the publication. Thus work in the field can be critically evaluated and classified as it progresses, and the probability of one's being influenced by any single study, when interested in a particular subject, will be reduced to the question of whether the study is an adequate one from the point of view of reliability, validity, sampling, and other similar criteria of research.

A research study is a good one if it attacks a limited question in a concise statement, if its methods and techniques exhibit originality, if its assumptions are valid and clearly defined, and if it makes a contribution to present existing knowledge. At the same time, the problem must have satisfactory scope and importance, the techniques must be adequate to collect valid and reliable data, and the quantity and quality of the data sufficient to leave little doubt as to the correctness of the conclusions. A problem meeting these requirements to some degree may be considered major research. An example is the study by Kurtz.[2]

By referring to this study one can note the adequacy of the form of report, the control of experimental factors, the quantity and quality of the results, all of which allow us to place a considerable amount of importance upon the reported conclusions and their value in determining future clinical practice.

A problem of smaller scope, containing the same general factors, and including a sizeable amount of data pointing to significant conclusions or trends, may be considered minor research. From this type of research may originate a study of major proportions or a significant survey. However, on account of the lack of sufficient data, the conclusions must be regarded as temporary, awaiting further substantiation. Their value is not as clearly indicated as in the case of major research. Minor research is to be distinguished from a partial report of a larger study, the publication of which is justified when the findings are running so strongly in a single direction as to warrant changing present practice. The report of a larger, uncompleted study serves the purpose of making

[2] J. L. Kurtz, "The Reliability and Variability of the Near Point Accommodative Tests," *Amer. Jour. of Optometry*, October, 1936.

the optometrist more alert to questionable present practices, and calls for more critical observation and evaluation of phenomena in everyday clinical practice.

A worker is justified in reporting a single case study provided it is done adequately. The problem should be presented clearly, the experimental factors isolated as nearly as possible, and the techniques and results should be elaborately criticized from the standpoint of reliability, validity, present practice and logical interpretation. In these criticisms outlining the possibilities and limitations of the method or technique lie the value of reporting a single case study. About twenty case studies would constitute a major research provided they relate to a single problem with adequately controlled experimental factors.

Discussion of a problem, method, technique, or practice should be concerned chiefly with points of view or interpretation. A discussion is valuable only in proportion to the degree to which all relevant factors have been kept in mind, and to the clarity of thought involved in their interpretation. Any discussion should be accompanied by adequate references to the points of view mentioned in the form of citations and a complete bibliography. However, many writers explain their own logical ideas, ignoring, or being ignorant of, important evidence on the subject. Besides this, they often neglect to mention the quantity and reliability of their statistical evidence. Note to what extent the discussion by Swann[3] can be considered a good one in the light of these criteria. Then compare this discussion with the one by Tinker,[4] or that of Zevin.[5]

A library study is significant if it collects and organizes work done on a special subject or in a particular field. Its value lies in the critical evaluation of the known studies, and in the bibliography which should be as complete as possible. At the present time it is difficult to find many divisions of the field of optometry which have reported several good research studies on the same subjects. As mentioned in a previous paper, this is due partly to the infancy of the field, and partly to the fact that optometrists have come out of schools with very little background in anything but the fundamentals of optometry.

Editorials and book reviews also play a part in the growth and improvement of the field. It is important that an editorial be constructive; that it express a point of view in terms of criticism designed to show methods for improvement of optometric practice and theory. In general, book reviews may be criticized on at least two grounds; they are inadequate, and they are non-critical. Their inadequacy lies in their failure to give sufficient information about the book. Very few reviews

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[3] L. A. Swann, "Functional Disturbances of the Eyes," *Amer. Jour. of Optometry*, January, 1936.

[4] M. A. Tinker, "An Evaluation of Eye-Movement Measures for Optometrists," *Amer. Jour. of Optometry*, January, 1938.

[5] N. A. Zevin, "A Discussion of Some Present Methods of Case Procedure and Their Interpretations," *Amer. Jour. of Optometry*, May, 1936.

compare the book, or its author's point of view, with that of others. Only a small per cent list a table of contents. A more serious fault is their lack of critical evaluation. The majority of reviewers point out the good qualities of the book frequently by making general statements in praise of it, but they neglect to mention the sections deficient in quality or completeness.

The progress of optometry depends upon the quality of the research, and the application of the findings in clinical practice. The optometrist should therefore be guided in his reading by a thorough critical evaluation of known and indefinite facts, establishing their reliability and validity as they appear, according to criteria of research.

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THE ROLE OF VITAMIN A DEFICIENCY IN SKIN AND EYE DISTURBANCES*

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The role that the vitamins play in the normal functioning and proper health maintenance of the human body has become understood only since the early part of the twentieth century. Previously, certain diseases such as scurvy, pellagra, and rickets, have been vaguely suspected as being caused by a lack of certain important and necessary elements in the food of the victims of these diseases. But the vitamins as such, were not specifically known to medical science in the years before this century and were not recognized as the specific cause of these diseases.

The vitamins were first chemically isolated by Funk during the early part of this century, and since then great strides have been made in the further study of vitamins. Various other workers after patient research and investigation, have been able to differentiate and segregate different types of vitamins. Whenever one of these new vitamins has been discovered, concurrent intensive clinical studies and laboratory experimentation were undertaken to determine their real function in the body economy. Much data has been accumulated on this subject and now the role of the vitamins is no longer a mystery to us. On the contrary it is acknowledged that the medical profession has uncovered many of the true functions of the vitamins, and their relationship to health and disease in our bodies. We now fully appreciate the importance of an adequate supply of vitamins in our food, and appreciate that the lack of these vitamins will result in pathological changes directly caused by the hypovitaminosis.

At present we recognize seven distinct and separate vitamins. These are designated by the letters A, B, C, D, E, F, G, in order to distinguish them from each other. Each vitamin has a distinct chemical formula which separates it from the others in the group, and which makes it a distinct chemical entity. Some of the vitamins are soluble in oil, while others are water soluble. They are all usually destroyed and broken down by the extremes of heat and cold, (thermolabile) so that they lose

*An abridgment of material appearing in the Columbia Optometrist, the publication of the Alumni Association, Columbia University School of Optometry, New York City.

their potency when exposed to these physical agents.

Vitamins are usually found in great abundance in most of the foods which we commonly eat. A person who is on an ample and well balanced diet will obtain a sufficient supply of all the vitamins essential for his well being. Milk, butter, vegetables, fruits, egg-yolks, and cod liver oil are foods which are especially rich in the different varieties of vitamins. The inclusion in our diet of these foods, is therefore especially advantageous to those who desire to obtain an adequate supply of the vitamins.

From an accumulation of data obtained by many investigators who have been engaged in the study of the function of the vitamins, it is now recognized that the various vitamins play different roles and control different functions of the body. One vitamin is recognized to be essential for growth; another vitamin is an essential factor in reproduction while still another is necessary for proper vision, etc., etc. Most of the important body functions require the presence of certain vitamins in the body, in order that the person shall maintain a normal state of well being.

Frequently some of the vitamins do not find their way into the body in sufficient quantities, because certain individuals restrict their diet for various reasons. Occasionally people maintain themselves on a poorly balanced diet, either on account of fallacious ideas about some peculiar dietary problem, or because of gullibility in accepting the theories expounded by faddists and cultists who blatantly preach the benefits of special diets. These quacks and charlatans have peculiar erroneous notions about diets, but they spread their gospels at street corner meetings and elsewhere, where they frequently convert others to accept their views. As a result of such dietary restrictions, there frequently develops a condition of deficiency of several of these important vitamins in the body. This primarily occurs, because the vitamins are not sufficiently present in the foods which are advocated by the faddists. And as a result of this vitamin deficiency, certain definite pathologic changes gradually develop, with resulting manifestations of diseases in various organs of the body.

I shall discuss in this paper only some of the diseases caused by the deficiency of vitamin A in the body, mainly because this particular vitamin is of special interest to students of the eye as well as to the dermatologist. The optometrist and ophthalmologist should have a decided interest in the functions of vitamin A, because this vitamin is absolutely essential to the normal function of the eye. It is now accepted as a proved fact, that without vitamin A there can be no vision. Also the efficiency with which the retina resynthesizes visual purple after its exposure to the light, has been found to be a satisfactory method of determining the deficiency of vitamin A in the body. A delay in the resynthesis of the visual purple results in so-called night blindness. This night blindness is now recognized as an important traffic problem and the cause of many automobile accidents at night.

The deficiency of vitamin A in the body also results in pathological

changes in the cornea which causes an opacity of the organ, and a tendency to corneal ulceration and infection. In the most advanced form, this corneal disease caused by vitamin A deficiency, is called xeropthalmia. These eye changes can be experimentally readily reproduced in guinea pigs and white mice by withholding this essential vitamin A from the diet of these animals. We therefore have a ready proof of the corneal diseases caused by vitamin A deficiency.

The skin is also markedly affected by the deficiency of vitamin A in the body. The lack of this vitamin causes the skin to become dry and scaly, and this is especially noted on the extremities. Both the sebaceous and sweat glands are diminished in their activities, and operate at a low level as a result of hypovitaminosis (A). There therefore results a reduction in sweating, and a diminution in the oily sebum on the skin which causes this organ to become dry and scaly. At the same time the nails also become dry and brittle and appear lusterless. Under the lack of vitamin A, there also develops on the skin, numerous follicular keratotic small papules, which are usually smooth-topped, and these lesions usually are present on the extensor surfaces of the arms and thighs.

All the eye changes and skin changes described above as due to the lack of sufficient vitamin A in the body will show a remarkable improvement and rapid disappearance, when sufficient vitamin A is added to the diet of the individual. The ingestion of food which is rich in vitamin A will readily show remarkable clinical cures in the corneal pathology, and there will be reestablishment of normal function of the retinal physiology. At the same time the dryness, scaliness and other abnormalities of the skin due to the vitamin A deficiency will show striking clinical improvement and return to normal appearance after sufficient vitamin A has been added to the diet of the individual.

An interesting case showing the peculiar abnormalities of the skin, and deficiency of vision caused by the insufficiency of vitamin A in the body, was recently observed by me in a patient who was admitted to a hospital for emergency treatment after injuries incurred in an automobile accident.

This case is reported in detail because it so classically showed definite symptoms of night blindness and skin changes. The cause of the lack of vitamin A in this individual was readily ascertained after questioning the patient. He frankly admitted that he had restricted his diet to nuts and boiled milk for long periods, in order to obtain relief from protracted attacks of colitis from which he had been suffering for many years. It is also to be noted that the patient showed remarkable improvement of his vision and the skin became normal after he was placed on a full diet which was rich in all vitamins, and especially rich in vitamin A.

CASE REPORT

W. B., aged 35 years, white, single, was driving his automobile at night on June 1, 1937 on one of the main thoroughfares in this city, when his car collided with an El pillar with resulting wreckage of

the automobile, and numerous contusions, abrasions, and laceration of the driver. An ambulance was called to the scene of the accident, and he was taken to the hospital for treatment of his injuries. While he was confined in the hospital, he volunteered the information to one of the interne staff, that he usually did not drive his automobile at night, because he was always confused by the glare of the headlights from automobiles passing him in the opposite direction. He stated that he had many narrow escapes from automobile collisions in the past few years whenever he drove his car at night. He stated that during the past few years he never drove his car at night unless it was absolutely necessary for him to do so, because he was afraid that he would have an accident such as finally did occur.

During the course of the examination and treatment of his numerous contusions, abrasions, etc., it was noted that his skin was quite dry and there were marked roughness and scaliness of the extensor surfaces of the arms and thighs. Also his nails were brittle and lusterless.

I was called in consultation by the surgical staff, with a request that I treat this patient for his skin abnormality. After a thorough examination, I recognized this skin condition as being caused by deficiency of vitamin A in the diet. In order to corroborate my diagnosis I questioned the patient carefully about his diet and food habits, and he told me a very interesting story. He stated that he had been troubled with severe colitis for many years, and that he had been treated by several physicians several years ago with only slight improvement of the colitis. He stated that in desperation he drifted to various non-medical cultists such as chiropractors and naturopaths who did not however, relieve his colitis.

One day he heard a lecture on a street corner by some food faddists, who extolled the benefits of a strict milk diet for different intestinal diseases. He became convinced about the merit of these claims, and decided to subject himself to this treatment. He stated that he went on a strict boiled milk diet for several months, and that it checked some of his symptoms. He believed also that eggs, meats, butter, and cheese and vegetables did not agree with him, so he gradually practically eliminated these foods from his diet for the past few years. He occasionally ate bread, chicken, and nuts, and he practically depended on these foods beside the boiled milk for his nutrition.

He stated that he got along fairly well on his diet, and that there was an improvement in his colitis. Although he noted that his appetite gradually became poor and he felt weak at frequent intervals, he attributed these symptoms essentially to his intestinal condition, rather than to the diet which he followed.

About two years ago he began to notice that he was especially troubled by the glare of strong lights. He noticed that when he drove his automobile at night he was blinded for quite a long interval by the headlights of automobiles passing in the opposite direction. He had

several collisions while driving his car at night, and on several occasions had escapes from accidents which he realized might have had a serious consequence. He noticed that he was able to drive his automobile quite well during the day time, and he had no bad experiences while driving in daylight. He finally concluded that night driving was too hazardous for him and drove his automobile at night only on rare occasions. He stated that he drove his automobile the night of the accident because he had to attend to an urgent business matter.

In view of the fact that this patient so obviously showed some of the major symptoms of vitamin A deficiency, such as night blindness, skin changes, poor appetite, and weakness I immediately ordered that he be put on a full diet consisting of unboiled milk, cheese, butter, eggs, and all vegetables, etc. I also prescribed for him a tablespoonful of codliver oil three times a day, to make sure that he would obtain an abundant supply of both vitamin A and vitamin D. He took this diet with practically no gastro-intestinal intolerance, and there did not develop any aggravation of his colitis symptoms. He soon began to show considerable improvement and gained weight and strength rapidly. After being on this diet for about two weeks, there was noted also marked improvement in the appearance of the skin, which was now much smoother and only slightly scaly. The nails also began to show more lustre and were not as brittle as previously. He was discharged from the hospital after remaining there for about three weeks making a complete recovery from the injuries suffered in the accident. I strongly urged him to continue on the diet which I prescribed and not to revert to his former restricted diet. He promised faithfully to do this, and admitted to me that he formerly had erroneous ideas about food.

This patient came to my office about three weeks after he was discharged from the hospital. There was a striking general improvement in his physical condition. He had gained about ten pounds in weight, and he stated that he felt much stronger and vigorous now. There was practically no roughness of the skin noticeable on the extensor aspect of the extremities. He stated that there was a distinct improvement in his vision during the past few weeks, and that he was not troubled now by the glare of lights at night. He said that he recently rode in an automobile as a passenger on a few occasions, and that he did not seem to be bothered by the glare of headlights from the passing automobiles. He asked whether I did not think that he might try to drive at night himself to determine whether it would still be hazardous for him to do this.

In view of the fact that he was continuing on the liberal diet which was very rich in vitamin A, and also in view of the marked improvment of the skin condition as well of his general well being since he went on this diet, I felt that his night blindness was most probably entirely improved by this time. I therefore told him that I believed that he could most probably drive an automobile at night without extra

hazard to himself or others. He promised to have his brother who is an experienced chauffeur sit next to him while he was driving, so that he would be immediately relieved of the wheel if he experiencd any of his former difficulties while driving.

This patient was seen again a few weeks later, and he reported further progress in his improvement. He stated that he continued to feel stronger, and that he had practically no intestinal complaints since he was discharged from the hospital. He was quite pleased with himself in general, and stated that he has had no difficulty with his vision since he saw me the last time. He stated that he experienced no difficulty when driving his automobile at night, and that he was no longer troubled by the glare of the headlights of passing automobiles. He said that he had driven his automobile practically every night during the past few weeks, and that he had no accidents or unpleasant experiences while driving. He stated that he felt that his former night blindness was now a thing of the past, and he expressed his gratitude for having been corrected about his dietary errors.

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A CONSIDERATION OF THE USE OF THE TERM OCULAR DOMINANCE*

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The literature contains numerous and varied uses of the term "dominant eye." While these uses differ as to the methods of determining the relationship between the eyes and in interpretations of the relationship, there is a common assumption that in normal binocular functioning one eye dominates over the other. It is with the assumption of such a unitary factor that this paper is concerned. The dominance is assumed to be evident in the greater use of one eye, in greater sensitivity, in lead movements, or in greater preference for one eye whenever a choice must be made between them.

Implications have ranged from the assumption that laterality of manual functions is determined by eye dominance (Parson, 23) and that eyedness is an indication of central laterality (Jasper, 16; Orton, 21), to the belief that methods of teaching reading should be influenced by the factor (Orton, 21, 22). The agreement between so-called dominant hand and dominant eye has been described as preferable to a mixed laterality of these 2 functions (Oates, 20; Dearborne, 9).

While each use of the term "ocular dominance" commonly implies that the characteristic is a unitary factor, there are many methods of determining it. If the unitary factor exists, however, each test should indicate the same laterality, or if there is lack of agreement, it is presumably implied that some tests are not good measures of eye dominance. The lack of agreement may be an indication, on the other hand, that ocular dominance is not a general, unitary factor; that it is specific to the method of measurement, and to the situation in which the test is made. Evidence from experimental measurement and from ocular neurology and physiology is to be presented to indicate that a general eye dominance as commonly conceived does not exist. It is not the purpose of this paper

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to review the literature in detail but, rather, to cite representative studies. Reviews of the field have appeared in recent publications (18, 25).

EXPERIMENTAL EVIDENCE

The most common tests devised to indicate "eye dominance" have been various kinds of sighting procedures. These tests measure a preference for one eye over the other in situations where only one eye can be used. Cone-shaped sighting devices, peep-hole sighting, and pointing methods are examples of such procedures. Four points of criticism of these methods as indications of a general factor of eye dominance may be listed.

(1) There is no justification for the belief that the "sighting eye" is preferred, dominates, or assumes leadership in normal binocular vision, although such a belief is often expressed. On the contrary, some recent experimental evidence indicates that during "normal" stereoscopic vision, simple interfixation movements, and convergent and divergent movements, neither eye tends to assume leadership.

Clark (3) reported that, while one eye moved first from 75% to 88% of the time, there was no significant relationship with the sighting eye as measured by the V-scope method (19). In a study of the time required to complete divergence movements during fixation in reading (2), it was found that there was no significant difference in 60% of the cases. In 25% the sighting eye (Miles V-scope) completed the movement first and in 15% the movement was completed first by the "non-dominant" eye. Clark (4) in an investigation of convergence and accommodative convergence found no significant difference between the behavior of the "dominant" and "non-dominant" eyes (Miles V-scope) for a variety of factors considered. Jasper (16), on the other hand, reported a somewhat greater tendency for the left eye to move first in righthanded subjects and the right eye to move first in lefthanded individuals. However, Jasper's data were not obtained during "normal" binocular functioning so they are not directly comparable. It should be pointed out that eye-movement studies can give only indirect evidence in regard to dominance in visual *perception*.

There is also evidence (3) that, due to eye-movement during stereoscopic vision, clear vision shifts from one eye to the other with no dominance evidenced. Washburn (28) has pointed out the importance of shifting perception from one eye to the other in stereoscopic vision.

(2) The agreement between different "sighting" tests, while positive, is not high enough to insure that all are measuring a unitary factor. Even relatively similar methods frequently give differing preferences. Variations in situation and procedure change the results. Thompson (26) used 5 different "sighting" tests in a study of 86 subjects. In no case was there perfect agreement between any 2 tests, the percentage of agreement ranging from 60 to 81.

Buxton and Crosland (1) used 4 tests of sighting with 86 subjects

and found that, while the reliability quotient of each was from .87 to .98, the intercorrelations varied from .44 to .71, only 2 being above .46. They conclude that "the existence of a 'unitary' trait of eye-preference is not indicated."

(3) Research on sighting by Crider (7) has indicated that, with rigidly controlled criteria and a large number of measurements, the consistency of choice of one eye is diminished and the proportion of "ambi-ocular" individuals increases. Whereas 93.34% of subjects used one eye consistently in 2 trials, only 50.45% used the same eye throughout 45 trials.

(4) The agreement between "sighting" tests and other so-called "eyedness" tests is little better than chance. In the study already mentioned, Thompson (26) found the "sighting" tests in agreement with convergence and chromatic tests for from 45% to 62% of the cases. Washburn, Faison, and Scott (27) found that the preferred eye in sighting, using the Miles V-scope, was the more responsive eye in retinal rivalry in only 33% of 57 cases. Visual acuity has been found to have no relationship to "sighting eye," or to other measures intended to show dominance. Moreover, the proportion of right-eye and left-eye superiority is a matter of chance. Of Thompson's (26) 86 subjects, 43, or 50%, had no measurable superiority of acuity in either eye; 34% had a more acute left eye; and in 16% the right eye was superior. Gahagan (13) using 100 cases of definite preference for right or left eye in peep-hole sighting, found 40% having equal acuity. Of the remaining 60 cases, 45% had greater acuity of the left eye and 55% greater acuity of the right eye. Of these 60 cases having unequal visual acuity, 27 preferred the less acute eye in the sighting test and 33 used the more acute eye. Schoen and Wallace (24), using 8 observers, reported that the relative flicker frequencies for the right and left eye were not reliably different. This was believed to indicate that "retinal events are unrelated to ocular asymmetry."

A relationship has been suggested between muscular imbalance and the "sighting" eye. In a study of 143 pupils having muscle imbalance in one eye, Crider (5) reported that they generally used "the eye having the most efficient musculature" in sighting with the manoptoscope and in Selzer's digit reading stereoscope device. Another study (6) of 257 cases of muscle imbalance confirmed the belief that the eye with muscle deficiency was "seldom the sighting or dominant eye." Schoen and Schofield (25), on the other hand, found no significant difference in diplopia threshold and a significantly greater duration of post direction diplopia in the "dominant eye." In 9 out of 10 subjects, they found greater "neuro-muscular efficiency" in the "non-dominant eye," but the differences were slight.

The greater activity of one eye in retinal rivalry has been suggested as a better test of eyedness than sighting (27). The fact that there is little agreement between the two situations is better explained, however,

by the recognition that each measures a different function, rather than a hypothetical general factor of dominance. Similar conclusions are indicated by other ocular measurements, in which, if a consistent laterality is found, there is little agreement with other functions.[1]

NEUROLOGICAL EVIDENCE

Underlying most descriptions of ocular dominance is the assumption, either implied or explicit, that ocular dominance is one manifestation of cerebral dominance. However, neurological evidence based on pathological and experimental data does not support this point of view. The distribution of both sensory and motor nerves is evidence against the conclusion that any so-called ocular dominance is an indication of central laterality.

The evidence concerning the motor nerves indicates that some of the fibers cross and others do not (10). The fibers of the third nerve are partly direct and partly crossed. The decussation of the fibers of the fourth nerve is probably incomplete also, although there is some evidence that it is complete. The fibers of the sixth nerve do not cross. In other words, the motor functioning of each eye is controlled by both cerebral hemispheres.

The evidence for the optic nerve (sensory) is similar (10). Both cerebral hemispheres are represented in each eye in the peripheral parts of the retina. The left half of each retina is represented in the left hemisphere, and the right halves in the right hemisphere. The neurological data for the macula are somewhat confusing. There is evidence in such phenomena as the "sparing of the macula," after certain cerebral lesions, that the macula receives fibers from both hemispheres, but the evidence is not final on this point. Harris (15), for example, presents an opposing point of view. Fox and German (11), after reviewing several cases, conclude that the macula is not bilaterally represented.

These data, for both sensory and motor functions, indicate that an ocular dominance in any specific situation cannot be considered as a manifestation of dominance of one cerebral hemisphere. *Since the functioning of either eye as a whole is dependent upon both cerebral hemispheres, such functioning cannot be an indication of dominance of either hemisphere.*

CONCLUSIONS AND RECOMMENDATIONS

Since the term "dominant eye" appears frequently in the literature,

[1] Witty and Kopel (29) reported that there is no relation between "laterality," including "eyedness," and reading disability. They compared 100 poor readers, all above 80 IQ, with a control group of normal readers. "Handedness" was determined by a questionnaire, "eyedness" by 3 sighting tests. There was no relationship between handedness or eyedness and the degree of reading disability; mixed eye-hand dominance had no bearing on reading. Crosland and Anderson (8) found greater score in "range of attention" tests on the side of the sighting eye. The dominant eye in sighting was determined by 4 sighting tests in which it was reported that there were no inconsistencies among 120 subjects. Other investigators have failed to find such agreement.

and since it will probably continue in popular use, there is need for recognition of certain limitations in the use of the term. Eye dominance as a single unitary factor does not exist. Laterality of eye functioning is specifically determined by the situation in which the measurement is made. The relationships between the eyes in such specific measurements is not an indication of any cerebral dominance. Sensory neural organization indicates that the problem of central functioning involves determining relationships of the two halves of the retina rather than the two eyes as a whole.[2] The motor functions of the two eyes are controlled by both hemispheres and cannot be studied from the point of view of cerebral dominance.

In view of these facts, it should be urged that in the use of the term "ocular dominance" the specific method of measurement be included in the statement of laterality. From this point of view, even the unqualified use of the term "sighting eye" is questionable since the situation frequently determines the eye used in sighting.

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[2] It may be mentioned that several studies have been reported of the laterality of peripheral portions of the retinas. Franz, *et al.* (12) studied asymmetry of perception, learning, etc. Gaskill (14) found the 2 halves of the retinas not significantly different in discriminating light intensity. On the other hand, Jasper and Raney (17) have found consistent laterality for the direction of perception of apparent movement in the periphery of vision.

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THE CONTROL OF PRIMARY GLAUCOMA BY OPTOMETRIC MEANS*

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Miosis is thought by many to be the factor in the relief of glaucoma. While eserine or pilocarpine cause miosis, it does not seem likely that it is the cause of relief of increased intraocular pressure.

The pupil contracts in sleep and yet intraocular pressure is greatest in the normal or glaucomatous eye just before getting out of bed[1] in the morning.[9] Relief from increased tension by means of eserine or pilocarpine is apparently caused by contraction of the ciliary muscle which exerts a three fold influence.[2] It diminishes the blood supply to the anterior portion of the uveal tract by constricting the anterior arteries as they pass through the muscle belly; it opens up the choroidal veins and it opens up the canal of Schlemm by traction on the scleral spur. The same end results will be caused whether the ciliary muscle contracts in normal accommodation or with drugs.

It would seem that accommodation of itself would cause an increased tension because there is positive experimental evidence to prove that traction on the choroid during accommodation causes the vitreous to be advanced. Enlarged photomicrographs of monkeys' eyes fixed after instillations of eserine and atropine show that the vitreous is pressed forward against the periphery of the lens, the zonule and the ciliary body under eserine; while an open space exists between these structures in atropinized eyes.[3]

Actual practice reveals that accommodation appears to cause a reduction of tension as was just shown.[2] Furthermore, statistics show that age or the refractive condition have no effect on intraocular pressure.[1] If accommodation caused increased tension, then presbyopes and myopes would have less tension than hyperopes and emmetropes of younger years.

The reason glaucoma is more prevalent in hyperopes is probably because our population is made up of many more hyperopes.

According to Duke-Elder, pilocarpine, eserine and atropine all cause dilation of the intraocular capillaries, increasing their permeability, and

*An abridgment of the material appearing in the Columbia Optometrist, the publication of the Alumni Association, Columbia University School of Optometry, New York City.

thereby increasing the fluid content of the eyeball.[4] However, pilocarpine and eserine at the same time cause a contraction of the ciliary muscle facilitating drainage of the eyeball. Atropine relaxes the ciliary muscle allowing more blood to enter the anterior portion of the uveal tract, at the same time abolishing traction on the choroid and allowing the veins of this organ to collapse adding further to congestion.

Eserine causes a rise in pressure in the normal eye. According to Duke-Elder[28] this is caused partly by dilation of the minute intraocular vessels and increased permeability of their walls, and partly by increased tonicity of the recti. Eserine does not cause a rise in pressure in the glaucomatous eye probably because the increased tension will resist dilation of the intraocular vessels, the extent of such resistance depending on the amount of tension. It seems very doubtful if eserine causes contraction of the recti because this drug would certainly cause a further increased tension in a glacomatous eye.

While a tenotomy of the recti lowers the pressure (Schönberg, 1913, Salvati, 1924),[29] and the fact that pressure of the eye falls to almost half of its original height when the recti are paralyzed by curare,[29] and stimulation of the recti to contraction by acetyl-choline causes increased pressure, we must consider that medical or surgical interference of the recti is not a physiological condition. The recti and obliques cannot be considered as causating factors of glaucoma because the pressure in the normal or glaucomatous eye is highest just before getting out of bed in the morning.[1] Furthermore Adler has shown that use of the eye in glaucoma seems to keep the tension from increasing.[30]

The effect of light on the intraocular pressure introduces a factor that cannot be overestimated in importance. Feigenbaum (1928-29) showed that in dark adaptation the intraocular vessels dilate and that the tension rises.[5] He found this to be so in blind as well as seeing eyes, occurring indifferently in aniridia, after an iridectomy, and with atropine or pilocarpine. It has also been shown that the introcular capillaries constrict on exposure to light causing a drop in pressure.[6]

Since the tension is greatest just before arising in the morning,[1] it seems very likely that this increased tension is due to sleeping in the dark. *Glacomatous patients therefore should be advised to sleep in lighted rooms instead of dark,* the minimum illumination required depending on experimental findings. It is also to be determined if this phototropism can affect intraocular pressure by exposing merely the skin of the head and face or any other part of the body.

According to Gradle,[7] of glaucomatous patients kept in a very dark room for one hour, more than 50 per cent will show the tonometric findings at the end of this period to be increased from 15 to 40 mm. Hg above the reading taken before being placed in the dark room. Upon exposure to strong light, there follows a *sudden* drop in tension to the *previous level.*

This fact appears to prove that it is the actual dilation of the intra-

ocular vessels and not the increased dialyzed fluid content (thought to be caused by the increased permeability of the dilated vessel walls) of the eye ball that causes the increased pressure. If the increased tension were actually due to the increased dialyzed fluid content, exposure to light would cause a very *gradual* drop in pressure because it would take some time before the excess fluid would become absorbed. This fact also seems to show that the active factor in the causation of glaucoma cannot be interference of drainage.

Gradle claims this increased tension is due to partial obstruction of the angle of the anterior chamber due to dilation of the pupil. As was previously shown the size of the pupil does not seem to affect the intraocular pressure because it is greatest just before getting out of bed in the morning[1] even though the pupil contracts in sleep.[9] An atropinized pupil will also contract[8] considerably in sleep.[9] Furthermore, if the dilation of the pupil causes the increased tension, why isn't there an increased tension in all the cases submitted to the dark room test?

As was previously shown, dark adaptation causes dilation of the intraocular vessels resulting in increased tension in blind and seeing eyes, occurring indifferently in aniridia, after an iridectomy and with pilocarpine or atropine.[5]

According to Gradle only slightly more than 50 per cent of glaucomatous eyes submitted to the dark room test show an increased tension. The reason that the other 40 and some odd per cent do not show this increase is probably because of a loss of tone of the capillary and arteriole walls, or because of arteriosclerosis involving the intraocular vessels. However, these 40 and some odd per cent will reveal increased tension after remaining in darkness a long time, for, it was shown that everyone has increased tension in the early morning hours.[1] Furthermore, Adler has shown[33] that, after the onset of presbyopia in middle life, chronic simple glaucoma reveals abnormally high tension only during the night.

Sclerosed vessels have a reduced lumen (arteriosclerosis causes a thickening of the walls inwardly thereby reducing the lumen of the vessels)[35] and the vessels so affected will be able to dilate to a very limited extent, if at all, depending on the extent of the arteriosclerosis.[10]

Arteriosclerosis is not to be assumed to mean the same as high blood pressure. It is established that there may be arteriosclerosis without high blood pressure at any stage, and high blood pressure without arteriosclerosis.[11]

The fact that dilation of the intraocular vessels in dark adaptation causes increased tension even in normal eyes may explain occasional ocular pains and headaches in movies or when arising from sleep in the morning when there is nothing else to account for the ocular pains or cephalalgia. I have some patients who get headaches in the movies only when going in the afternoon. These same patients never complain of headaches when attending a movie at night. The afternoon headaches

may be explained by the sudden change from bright daylight to the darkness of the theatre causing sudden dilation of the intraocular vessels. The reason everyone is not similarly effected is explained in previous paragraphs. Furthermore we do not all respond to the same stimulus in the same way.

Since eserine or pilocarpine are thought to cause relief of increased tension by the pumping action on the scleral spur, it seems very reasonable to believe that a pair of O.U.-0.50 sph. made up in a grab front could be worn and removed at intervals to induce drainage of the aqueous. In fact wearing and removing these minus spheres at intervals would induce a more satisfactory pumping action than the steady action of miotics, which also cause a dilation of the intradocular vessels.[4]

According to Adler[30] use of the eyes seems to keep the tension down. However, it must be emphasized that glaucomatous or eyes subject to glaucoma should be exposed to plenty of light. Avoidance of dark places and sleeping in lighted rooms may allow the complete discontinuance of miotics or other means used to keep the tension down.

The fact that dark adaptation causes increased tension even with pilocarpine[5] emphasizes very strongly that the proper use of light is the factor in treatment of primary glaucoma.

Since drugs and surgical interference do not insure against further attacks of increased tension,[34] the light treatment suggested herein should be resorted to permanently for the prevention of future attacks.

Luckiesh and Moss[18] found a progressive decrease in the heart rate as the duration of the visual task was increased, and that the decrement in the heart rate was much greater under 1 foot candle than it was under 100 foot candles. This phenomenon is probably due to the oculocardiac reflex.[19] Through an association of the trigeminal and vagus nerves increased pressure in or on the eye ball causes a slowing of the heart rate. In the normal state more blood flows to the eyes in the process of reading causing a dilation of the intraocular vessels, resulting in increased tension.

It is questionable if reading would cause the oculocardiac reflex in cases of arteriosclerosis of the intraocular vessels to the same extent as in those cases where no arteriosclerosis exists because of the rigidity and reduced lumen of the intraocular vessels.[10] This point is emphasized by the fact that only slightly more than 50 per cent of the cases submitted to the dark room test show an increased tension.[7] Since Adler has shown that use of the eyes in glaucoma seems to keep the tension from increasing,[30] it seems that an increased tension such as in glaucoma will resist dilation of the intraocular vessels caused by reading. It appears therefore that reading will cause the oculocardiac reflex only in eyes having normal tension and no arteriosclerosis of the intraocular vessels.

It is also doubtful if the oculocardiac reflex in people with one eye would cause as much slowing of the heart rate as in people with two eyes. In one-eyed people (those having only one eye) the stimulus causing the oculocardiac reflex would not be as intense as in people having two eyes.

Having two eyes with only monocular vision is not to be thought of as being similar to having only one eye, for, when one eye only is exposed to light the reflex travels to the other eye also, the conduction being stopped by an optico-ciliary neurectomy (Feigenbaum, 1928-29).[21]

It is the dilation of the intraocular vessels and not accommodation that appears to cause the increased tension. Since a reduction of illumination causes a further slowing of the heart rate, some may argue that more accommodative effort is required thereby causing increased tension. The factors that appear to elminate accommodation as a cause of increased tension are:

1. Tension[1] is greatest just before getting out of bed in the morning.

2. Use of the eyes seem to keep the tension from increasing in glaucoma.[30]

3. Miotics appear to cause a decreased tension in glaucoma.[4]

Grossman[32] found that in cases of aniridia the diameter of the lens under atropine is 12.25 mm.; under eserine 10.25 mm.; and in the resting state 11.50 mm. Some may therefore conclude that relaxation of accommodation during sleep may cause increased tension. This point may be ruled out because it has been shown that dark adaptation causes increased tension after the instillation of pilocarpine.[5]

The association of the trigeminal and vagus nerves is further revealed in the nausea experienced in cases of uncorrected refractive errors and in cases where the Rx is causing ocular discomfort. In these cases there will be increased vascularisation of the intraocular tissues. A more marked example is the vomiting in some cases of glaucoma.

Here we have an example of the "all or none" theory.[20] In uncorrected ametropia or where the Rx causes ocular discomfort, the tension is increased slightly, merely causing nausea. Where the tension is increased markedly as in glaucoma, more receptors of the trigeminal are stimulated causing a more intense stimulus resulting in vomiting.

An iridectomy may cause relief from glaucoma because:

1. The rate of aqueous secretion may be reduced because some portion of the intraocular capillaries are removed.

2. According to Parsons[22] it may be probable that additional drainage is absorbed by the cut edges of the coloboma, for wounds of the iris do not heal by cicatrisation, the lymph spaces of the iris stroma always remaining continuous with the anterior chamber at the cut margins.

3. Since it has been shown that light causes constriction of the intraocular vessels thereby reducing tension, it seems that an iridectomy causes relief from glaucoma chiefly because more light can now enter the eye. Mydriasis by atropine will cause increased tension. See reference 4. However, dark adaptation in cases of iridectomy will cause increased tension.[5]

Seefelder[36] found that out of 82 cases of congenital aniridia, 23 had glaucoma. However, the anomalous iris root, often found to be present in these cases by histologic examination,[36] was found to be usually directly

adherent to the posterior surface of the cornea, thus blocking the angle of the anterior chamber.[37]

The fact that dark adaptation causes a rise in tension primarily by dilation of the intraocular vessels in cases of aniridia or where an iridectomy was performed, with atropine or pilocarpine,[5] makes it seem quite evident therefore that interference of drainage is a very doubtful cause of primary glaucoma. Drainage of the eye occurs at a very slow rate in normal eyes and there is no reason why it should be worse in dark adaptation.

Histologic evidence reveals that the individual fibres of the pectinate ligament are somewhat thickened and sclerosed so that the character of the filter is changed and the total filtering area supposedly lessened.[12] According to Friedenwald[31] many cases of glaucoma are seen where no such lesion is found. He states further that there is no evidence that sclerosis of the pectinate ligaments interfere in any way with the movement of the fluid in the eye.

To show further that it is dilation of the intraocular vessels and not interference of drainage that causes increased tension, the following reasons are presented:

1. The *sudden* drop in pressure of glaucomatous eyes to the *previous level* when coming from darkness to light.[7] If the increased tension were due to interference of drainage, exposure to light would cause a very gradual drop in pressure.

2. Attacks of acute glaucoma come on mostly at night.[23]

From the evidence presented it seems that arteriosclerosis is both an obstacle and an aid in the control of glaucoma.

As age advances there is a deposit of connective tissue in the uveal tract,[13 14 15 16] and a thickening and sclerosis of the pectinate ligament fibres.[12] The choroid ,which is now more rigid, will resist stretching upon contraction of the ciliary muscle, will not cause the veins (of the choroid) to be opened out as much as in eyes not so affected. However, because of the choroid's resistance, the ciliary muscle's traction upon the scleral spur will be greater than in non-presbyopic eyes causing a greater opening into Schlemm's canal. Arteriosclerosis involving the intraocular vessels will resist dilation from whatever cause depending on the extent of the arteriosclerosis.[10]

The elasticity of the choroid in the young and aged is beautifully demonstrated in the time it takes for homatropine to cause cycloplegia in children and in presbyopes.[27] A drop of homatropine instilled in the eye of a person aged 40 years will cause lessening of the accommodation in ten to twelve minutes, while in the young it will take much longer. The choroid in one of forty is so rigid in comparison with that in one of younger years that the zonular fibres are rendered tense and taut in a shorter time. This fact seems to emphasize that presbyopia is due mainly to a loss of elasticity of the choroid. [13 14 15 16]

The continued use of eserine frequently causes an enormous hypertrophy of the subconjunctival follicles and a development of a severe conjunctivitis that may temporarily resemble an acute trachoma. Pilocarpine also causes a conjunctival irritation, but of a much milder form.[17 26]

CONCLUSION

The optometric control of glaucoma may be summarized as follows:

1. Sleeping in well lighted rooms.
2. At least 50 foot candles of illumination for close work.
3. Use of 0-.50 to -0.75 sph. at periodic intervals in a grab front.
4. Avoidance of movie theatres or other dark places until the condition of the eye allows, and exposure to good illumination at all times.

Since dark adaptation looms up as a major cause of glaucoma, the application of proper lighting facilities cannot be stressed too strongly.

This paper is presented in the hope that it will help to avoid primary glaucoma.

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FUNDUS EXAMINATION IN OPTOMETRY

W. W. Parker, Opt.D.
Toronto, Ontario

Optometry is thus defined by Sheard: "Optometry is the Science and Art devoted to the examination of the eyes, the analysis of ocular functions, the employment of optometric preventive and corrective methods and agents for the relief of ocular and visual anomalies."

This presumes that our working basis is a healthy eye, and as Optometry is confined within the limits of the above definition, it becomes essential for us to assure ourselves of the absence of any disease manifest in the eye, before prescribing for errors of refraction.

Our knowledge and use of the Ophthalmoscope and the understanding of what we see by its use is essentially for preventive measures, for we must be in a position to recognize any departure from the normal when we see it in order to know whether the above definition applies to the patient under our care.

An incipient morbidity could be easily overlooked without an ophthalmoscopic examination, some of the conditions giving no distress to their owners, and I would suggest that the French criminal code be applied to every eye that comes to us for examination, "It is guilty until it has proved its innocence," for while these conditions are not, strictly speaking, common, let us be sure of their entire absence.

It is comparatively easy to diagnose any trouble of an extrinsic nature, but when we come to the troubles of an intrinsic nature, that is something else again.

Let us acquaint ourselves with the normal fundus, for by so doing we kill two birds with one stone, for by recognizing the normal fundus we know that any departure from the normal state must be regarded with suspicion. We do not even have to diagnose the pathology in order to get this far, although it has never been quite enough in my opinion to find a low acuity which is not susceptible to correction, to use an ophthalmoscope and realize that the fundus is not normal, and relinquish the case to an oculist, without correct diagnosis. True, pathology is not our province, but the recognition of it most definitely is, and there is no

argument in the fact that it is as essential to know when to apply a correction, as it is when not to.

There are two methods of ophthalmoscopy, the direct and indirect methods. In the direct method the ophthalmoscope is held as closely as possible to the observed eye and the subject instructed to look into the distance of the dark room, relaxing the accommodation as much as possible. It is advisable for the observer to use the same eye as the one under observation, right for right and left for left. If the right eye is being examined the subject should be instructed to look past the observer's right ear, the observer using his right eye. If it is the left eye the left ear and eye of the observer should be used. It is usually necessary to revolve the battery of lenses embodied in the opthalmoscope in order to obtain a clear view of the fundus.

In the indirect method the observer's eye is about 30 inches from the eye of the patient, a condensing lense of 13.00 D. or stronger is held close to the observed eye, the third and fourth fingers of the observer resting on the forehead of the subject to steady the lens. The further distance between the observer and the subject makes it possible for the observer to examine both eyes of the patient without changing his own. The procedure then is similar to that used in the direct method. In instructing the patient where to look, the image appears to be formed in the air before the condenser. By holding the condenser close to the eye of the subject and gradually bringing it forward toward the observer the virtual image is seen first. A little further will bring the real image into view. This position when the iris cannot be seen is the correct one.

The Bausch & Lomb Binocular Ophthalmoscope, with the head frame for the subject, the easy focusing of the instrument reduces ophthalmoscopy to something quite simple. The field is approximately four times as large as that seen with the hand instrument, is centered for stereoscopic preception of depth, fitted with light filters and fixation target, making a detailed examination of the fundus a comparatively simple matter. In fact, the instrument is calculated to make the opthalmoscopist break the tenth commandment. The instrument lays the picture before him. What he sees depends on his proficiency.

Let us now turn to the fundus. The floor of the fundus will vary in color, depending entirely on whether the patient is blonde, brunette, or somewhere in between, and if we extend the range from Negroid to Albino the variation will be greater, and will range from a light yellowish pink, red, red brown and brown black.

A brief anatomical review will help us realize more clearly what we are looking for.

The optic nerve enters the eye at the nasal side and a little below the optic axis. The area of the entrance of the optic nerve into the ball is known as the papilla. The optic nerve is really part of the brain and is covered by the same three sheaths, the Dural, the Anachroidal and the Pial membranea. The first two eventually losing themselves in the scler-

otic, the third to the Lamina Cribrosa. The retina may be regarded as an expansion of the optic nerve and extends from the optic disc forward to a little way past the equator, terminating at the Ora Serrata.

The Macula is situated to the temporal side of the papilla and while it is not easily seen in health, the location of it is easily discerned. We see from the centre of the papilla the central retinal artery and vein emerging. These extend above and below to the nasal and temporal sides of the fundus. In between the upper and lower temporal branches lies the macula, about 1.25 mm. to the temporal side of the papilla. The artery emerges from the papilla on the nasal side of the vein and may be distinguished from the vein by its lightness of color. The paths it follows are straighter and it is only about two-thirds the size of the vein. The course of the vein is more tortuous and its color wine red. The papilla is an ivory pink in color and a slight depression will be noticed on the temporal side. This is the physiological depression. The edge of the papilla should be well marked and surrounded by two rings, the Chorcidal and the Scleral. The Scleral ring is sometimes quite plainy seen, particularly in Myopia and up to a certain point has no real significance.

If the observer has seen all of the foregoing, he has satisfied himself of another important fact, that there has been no opacity of the vitreous lens or cornea. Were this not so, a good view of the fundus would be impossible.

To sum up the requirements of a normal fundus:

An even color of the fundus. The color being controlled by the pigmentation of the subject.

The papilla must be examined for form, size, margins, levels and vessels.

The form should be slightly oval vertically. Sometimes, in rare cases, it seems to be oblique or horizontal. This is not an anatomical fact but is produced by corneal astigmatism.

The size is actually from 1.5 mm. to 2 mm. Beginners sometimes include the scleral ring if it is visible and conclude that the papilla is enlarged.

The color: A homely example of the color is that of a peach, an ivory pink on the temporal side caused by the greater number of nerve fibres, to a deeper pink on the nasal side where they are less in number. The color will seem to vary in different subjects due to pigmentation or the lack of it. The darker the fundus, the more seeming white the papilla.

The fundus should be sharply defined. Regarding the scleral and choroidal rings, it is usual for the observer to only partially see the entire ring. For a number of reasons, most of them physiological, in some cases the rings are entirely absent. Age may account for the absence of the choroidal ring as there is a greater development of pigment in youth.

The levels: In the first place, when the papilla was so named it was supposed that the point of entrance of the optic nerve into the eye was

on a higher level than the surrounding tissue. This, again, is not an anatomical fact. It rises above the surrounding retina only in exceptional cases. The physiological depression is caused by the nerve fibres not completely filling out the hole in the choroid. They cling to the sides of the sclero-choroidal canal, leaving a funnel or cup-shaped cavity below the level of the surrounding tissue. The size of the cavity varies considerably in the individual; it may occupy only a small area or it may involve the entire surface. Should the excavation be abrupt, that is, when the veins run to the edge and disappear, when there seems to be no connection between the vein we see on the retinal tissue and the one perceivable on the floor of the excavation. Pathology is suspected.

The entrance of the retinal vessels through the Porous Opticus is again quite interesting. In some cases a single vessel is seen emerging, while in other cases two or three. This is due to the vessel dividing in the nerve before its appearance on the fundus. The vessels of the macula come from the superior and inferior temporal arteries which are subdivisions of the central retinal artery. There is no pulsation of the arteries under normal conditions. The principal venous trunks can often be seen pulsating, more especially when the bend from the retinal field into the cup is acute. Venous pulse may be accelerated by a slight pressure on the ball.

Arterial pulse must always be regarded as pathologic.

The macula area of the fundus contains a yellowish coloring matter which is considerably larger than the actual macula. It is surrounded by vessels but entirely lacking in them. It is oval shape, about 5 papillary diameters in length and about 2½ papillary diameters high. It is darker in the center.

Roughly speaking, we must be prepared to find three types of the normal fundus. The uniform or strippled fundus, the tessellated fundus and the albinotic.

The condition of the uniform is due to the fact that the pigment epithelium contains pigment of such quantity and denseness as to obscure the choroidal vessels which lie beneath.

The tessellated fundus is so named because there is less density of the pigment epithelium, enabling us to see the choroidal vessels. The fundus shows a tessellated pattern quite different to the uniform fundus but nevertheless quite normal.

The albinotic fundus is a condition where the epithelium contains so little pigment that an almost unobscured view of the choroidal vessels may be seen. But as these, too, are lacking in pigment, the white reflex of the sclerotic is discernible through them, making the fundus appear a yellowish pink. Cases are often met with that do not appear to belong to either type, but on close examination will be found to have the combined characteristics of the above-named types. There always seems to be more pigment in the region of the fovea and the macula, making the macula more easily discernible.

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ON THE USE OF ABBREVIATIONS IN OPTOMETRICAL LITERATURE

In many optometric offices it is customary to use certain abbreviations in case records. This is excusable for it saves space on the record chart and makes reference easy for those who know what the abbreviations mean. In material for publication, however, the use of abbreviations should be avoided as much as possible. During the World War, the craze for abbreviation developed, due perhaps to the large amount of so-called paper work necessary in governmental activities. More recently this type of careless usage has spread and we now find outcroppings of this development in the recent writings of some optometrists.

In a technical literature the general use of original or coined abbreviations should not be tolerated. Such abbreviations as found in this sentence, "As a result, I do know that when I am feeling poorly from L.B.P. I can administer a treatment which takes less than 15 min-

utes. . . . "[1] or from the same paper, "He has had H.B.P. since he was 35 years of age. . . ."[2] or what is even worse, the use of the abbreviation "Ro X I X,"[3] or what is much more common but not good usage, the employment of the term or abbreviation "O.E.P."[4] as sometimes found in optometric writings.

Few readers of this Journal, for example, can identify with ease the foregoing abbreviations even when they were placed in their proper setting. Most optometrists would have difficulty in translating L.B.P. into "low blood pressure" or H.B.P. into "high blood pressure," Ro X I X into "rotary cross-eye exercises." The optometric editor who is confronted with such hieroglyphics can sympathize with the diagnosis "G.O.K." which appeared on many case records in hospitals during the war, signifying "God only knows."

When abbreviations are used in optometric papers, in recording the details of ocular examinations or orthoptic procedures the meaning should be entirely clear to all persons who may have an occasion to read them. Optometric literature is read not only by optometrists but also by medical refractionists, educators, public health workers and others who may not have the exact technical background afforded the optometrist. Literature in this field therefore should be so written that the exact meaning of the author is clear to all.

Abbreviations not found in dictionaries or in all ordinary text books in this field of work should not be used in technical papers. Abbreviations of optometric terms are used obviously to save the time of the writer. Frequently, however, the time thus saved is wasted many times over by the person who is trying to decipher the meaning originally intended. It must be remembered that optometrical abbreviations when placed within an ocular context may be reasonably clear to those intimately familiar with this particular field, but when these abbreviations are removed from such environment they become quite abstruse. It must also be remembered that for the uninitiated the optometrist already possess the worst collection of uninterpretable abbreviations now used by any professional group and we should think twice before adding to this collection. Take for example Hm for "manifest hyperopia," or M.A. for "meter angle," or O.U. for "oculus uterque," or

1. P. B. Horton. Optometric Weekly. Sept. 22, 1938. p. 949.
2. P. B. Horton. Optometric Weekly. Sept. 22, 1938. p. 950.
3. S. B. Cox. Optometric Weekly. Sept. 22, 1938. p 951.
4. S. B. Cox. Optometric Weekly. Sept. 22, 1938. p. 951.

D.B.L. as "distance between lenses," D for "diopter," or x for "axis." These and many more are, to be sure, quite familiar to most optometrists but not so to all readers of our literature. It then becomes quite necessary to limit this sort of thing to that material wherein the intent and meaning will be clear to all.

In the preparation of a technical paper for publication in optometric journals the use of even these most common abbreviations should be avoided whenever possible. Coined abbreviations should never be used, as these require much time on the part of editors and readers to decode the meanings of such abbreviations. The use of coined abbreviations are merely short-cuts in expression and indicate a careless preparation of materials on the part of the author and are an abomination to the reader.

Carel C. Koch.

* * * * *

A NOTE ON THE USE OF AN ELECTRIC INTERVAL TIMER IN ORTHOPTIC TREATMENT WORK

Certain orthoptic procedures now employed by optometrists require the use of specific techniques for varied periods of time. The length of these periods being determined by the nature of the condition under observation and also the patients response to the technique employed. Once these factors have been established for each case, the period during which the particular technique is employed should fall within the prescribed limits for the patient being treated, to prevent undue fatigue. To assist the optometrist in controlling the time factor in these orthoptic cases the writer suggests the use of an electric interval timer which can be set for any required number of minutes, and which when so set will automatically inform the optometrist when the prescribed period of time has elapsed.

The device referred to here is a combined laboratory clock and interval timer, driven by an electric synchronous motor. The alarm is an electric horntone buzzer. This new and improved timer was fully described in THE LABORATORY, Vol. 5, No. 5.[1]

To operate this interval timing device, an upper dial is set to the

1. Made by Fisher Scientific Company. Pittsburgh, Penna. Black molded Bakelite Case. 110 volts, 60 cycle, A.C.

required number of minutes (1 to 120) and then a small lever is placed in the "on" position. At the end of the designated interval, the buzzer will sound and the dial can then be again reset when desired. Both the intensity and duration of the buzzer can be adjusted. Short intervals can also be accurately timed by observing the large red hand which makes a complete revolution of the face of the clock each minute. It might also be pointed out that the operation of the interval timing attachment does not interfere with the continuous operation of the clock proper, which also acts as a timepiece.

Carel C. Koch.

* * * * *

SOLICITING

At one time soliciting was a serious minor problem in optometry. As this was true in the early beginnings of this profession it was also true in the early development of every profession and in some is still a disturbing factor in the advancement of the very profession itself. In the optometrical profession the practice of soliciting for patients is today almost non-existent as most of the laws dealing with the regulation of optometrists in every way prohibit this practice. Then too, the colleges and universities have for years taught their undergraduate optometric students the unadvisability of this type of promotional effort on the part of professional people, and have thus developed in the minds of these younger members of the profession the keen realization of the undesirability of this type of practice building.

One might ask if it is an accident that the very act of soliciting should in fact describe the very mode of operation of a human calling. The answer would be in the negative. "Soliciting" itself as associated with any profession is a word of degradation. In the serious and thoughtful verdict of the public, the shyster doctor, the ambulance-chasing lawyer, the cut-rate optometrist, the painless dentist and the soliciting accountant are all prostituting their own professions.

This matter is again brought to the attention of optometrists because of the practice of a very few members of this professional group, who through the medium of "paid" newspaper space have been actively soliciting patients. THE AMERICAN JOURNAL OF OPTOMETRY would be recreant to its purpose if it failed at this time to again declare its

objective which is to promote and maintain high professional and ethical standards among optometrists and to discourage every unethical act of soliciting either directly or indirectly by members of this profession.

Richardson in his book on Ethics, indicts the soliciting professional man in this manner: "He solicited and, therefore, lost his professional standing. He attacked the reputation of a fellow practitioner and, therefore, became a cad. He quoted rates without knowledge and, therefore, became a fool. He attempted to cut prices and, therefore, became an outcast."

The optometrist who is just beginning his practice can acquire patients through ethical contacts. "Make friends in every proper way," says Richardson, "speak well of all members of the profession; never quote flat fees or reduce rates below those of other practitioners; never praise yourself; observe the golden rule."

Carel C. Koch.

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ABSTRACTS

QUARTZ OPTICAL CRYSTAL. F. C. Brueck. The Rhode Island Optometric Journal. Pp. 8-9, Vol. 10, No. 4, 1938.

One of the largest and finest quartz crystals ever to enter the United States went into the vaults of Bausch & Lomb Optical Co. recently. Coming from the Province of Minas Geraes in Brazil, the huge crystal weighs 63 pounds and cost $18.00 per pound. Based on optical quality, experts believe that it surpasses any museum piece of this type in the country.

Although quartz, a form of silica occuring in hexagonal crystals, is distributed throughout the world, no deposits of suitable optical quality have been found in the United States. Brazil is the chief source of supply and Bausch & Lomb is the chief purchaser.

The crystal is solid matter in its most perfectly developed and naturally organized condition. Its exterior is characterized by a form of extraordinary regular geometrical design. The internal structure is, likewise, so regular that the arrangement of the structural units, or chemical molecules, is precisely the same about one point as every other point.

"If the growth of the crystal has been slow, undisturbed and unrestricted in all directions," says Fred C. Brueck, who studied optical minerals for 25 years, "its external shape is that of a closed solid, the surface of which is entirely made up of numerous plane facets, or 'faces,' meeting in straight edges, brilliantly smooth, as if highly polished. The arrangement of these facets, measured by their mutual inclinations, is characteristic of each crystal. Frequently," says Brueck, "the facets are not only truly plane, but as highly polished as though done by a jeweler's lapidary."

Light is reflected and refracted through the crystal. Viewed in sunlight or bright artificial light, the scintillation of spectrum-colored rays shows the beautiful properties of transparent crystal.

Quartz is a uniaxial crystal—one with two different directions of refractive index—and the interference colors may be brought about by the phase difference in various wave-lengths of light. The crystal may absorb part of the components of white light, producing a definite color, which not only gives color to the mineral, but also modifies the tone of interference colors by removing from white light the components absorbed by the crystal.

Since the phase difference between extraordinary and ordinary rays emerging from a uniaxial crystal depends on the length of path traversed—thickness of the quartz plate—and on the relative velocities of the two rays, and the relative velocities depend upon the character of the crystal and the direction in which the plate is cut from it, the interference color is related to the thickness of the plate. If the plate is not uniformly thick, it will show interference colors in different places.

"Crystals are frequently found," says Brueck, "which are obviously of a composite character, or composed of more than a single crystal of the same substance, in which there are two, or even three, parts belonging to separate crystals, although they are united in a definite and regular manner. Their twin nature is often betrayed by the presence of what are known as 're-entrant angles,' forming notches, arrowhead shapes, knee shapes and cruciform, or heart shapes. Frequently two or more individual crystals are so intimately blended that the appearance at first sight is that of a single individual crystal, a crystal of a higher degree of symmetry than a single crystal."

Brazilian crystals are characterized by a peculiar kind of interpenetration "twinning," Brueck explains, as he examines a slab of quartz

under his polarizing microscope. "There are two different crystals in this one block. One piece has a right-handed movement like a clock, while the other has a left-handed movement, counter-clockwise. The interpenetration here is but partial and the twin has the appearance of a mirror-image, or reflection twin."

Brueck's duties are to determine the optical axis of the crystal before it is cut to detect flaws, and to extract the greatest proportion of usable crystal from the material. To do this, he uses plane polarized light, vibrating in a straight line, or circularly polarized light which vibrates in a circle, because the character of the crystal is more easily detected than in ordinary light. Quartz crystals exhibit among other things, one set of concentric colored circles, with a dark maltese cross extending across the field.

Quartz crystal are used by instrument makers for lenses and prisms because of their high transparency and the superior resolution obtained with this material in the shorter wave-lengths of light, such as the ultraviolet. The shorter the wave-length of light the greater the resolving power, disclosing more details in the structure under observation.

Although the microscope is now equipped with special ultraviolet accessories, it is in spectographs, spectrometers and monochromators that the chief necessity for quartz optics exists.

Biologists, cytologists and histologists benefit by the use of quartz accessories for the microscope because of the ability to differentiate better between various cell and tissue structures, while the spectroscopist utilizes quartz instruments in detecting various elements whose identifying lines lie in the ultraviolet portion of the spectrum.

T. O. B.

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ADAPTOMETER TO DETECT VITAMIN A DEFICIENCY.

J. Neumueller. The Optometric Weekly, p. 993, Vol. 29, No. 33, 1938.

According to Neumueller the American Optical Company has introduced a new instrument to ascertain whether or not a patient is deficient in vitamin A and thereby afflicted with night blindness. Night blindness is the inability of the eye to adapt itself to dim light. It is

responsible, according to Neumueller, for many of 1937's 22,000 auto fatalities which occurred during hours of darkness when only 20 per cent of the total traffic was on the road. Night blindness is definitely associated with various organic and functional disorders. It is usually caused by a deficiency of vitamin A. This essential vitamin regenerates visual purple, a substance found in the retina of the eye and necessary for seeing in dim light. Exposure to glare or strong light bleaches out the visual purple. A partial blind period results, lasting until the regenerative process restores the retina to normal. Persons deficient in vitamin A, or suffering from certain diseases or their after-effects, cannot regenerate visual purple as fast as normal people. To that extent, they are subject to night blindness and the possibility of accidents in low illumination.

The operation of the Adaptometer, as explained by Neumueller, is quite simple. The patient is seated in a dark room facing the instrument. His eyes are fixed on a strong light in the upper part of the instrument. This light bleaches out the visual purple in his retina. After a 3-minute exposure, the bright light is turned off and the patient is apparently in complete darkness. However, when the bright light is switched off a very weak test light is automatically switched on. The test light becomes visible to the patient only after sufficient regeneration of visual purple. The time of regeneration in normal cases should not exceed 5 minutes. If a longer time is needed, the subject is considered deficient in vitamin A and has night blindness. T. O. B.

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THE PROBLEM OF PROGRESSIVE MYOPIA. Ralph H. Green. The Indiana Optometrist. Vol. VIII., No. X., pp. 3-13. 1938.

Green reviews the entire subject of myopia presenting the Mechanical theory, the Endocrine theory, and the Hereditary theory of progressive myopia. He next reviews the subject from the standpoint of corrective measures outlining the possible procedures to be followed from the optical, medicinal, surgical and hygienic standpoints. From the optical, Green advises the use of a full correction for general wear with necessary compensation should the balance between accommodation and convergence be upset at the near point. Regarding hygenic measures Green suggests: (1) As little close work as possible should be attempted, and

in the school child only that absolutely necessary. (2) Reading should not be permitted in street cars, moving vehicles, etc. (3) Outdoor exercise of not too vigorous a nature should be encouraged and recommended. (4) Young myopes of greater than six or seven diopters should be recommended to sight-saving classes where such are available. (5) All close work should be done under the best lighting conditions; approximately thirty foot-candles are required for close work. (6) Correct posture should be encouraged. The patient should not permit the head to drop too far forward during close work. (7) In cases in which the progression of myopia is marked, they should be referred to a competent medical practitioner for a complete physical examination so that where necessary, systemic and-or organic conditions may be removed by the proper treatment. T.O.B.

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BROMBACH SCOTOMAGRAPH. Bulletin of the Optometrical Society of the City of New York. Vol. 4, No. 1, p. 7. 1938.

A new portable instrument for charting the central field of vision is described. This new piece of equipment was developed by the optometrist Brombach, the author of the well known book on field charting, VISUAL FIELDS. This new instrument is compact and easily carried from one place to another. Charts for keeping permanent records of the blind spot and any central scotoma which may be present are provided. The instrument is made by the American Optical Company.

T.O.B.

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BOOK NOTICES

AN EVALUATION OF VISUAL FACTORS IN READING. Henry A. Imus, A.M., Research Fellow, The Dartmouth Eye Institute, Dartmouth Medical School. John W. M. Rothney, Ed.D., Instructor in Education and Research Associate, Psycho-Educational Clinic, Harvard University, and Robert M. Bear, Ph.D., Assistant Professor of Psychology, Dartmouth College. Published by Dartmouth College Publications, Hanover, New Hampshire. 144 pp. Illustrated. Board covers. $2. 1938.

The subject of Reading Disability has engaged the attention, in

recent years, of Educators, Physicists, Optometrists and Ophthalmologists. Important research has been carried on in schools, laboratories and clinics. Much valuable data has been reported, but for the first time the investigation of this subject has embraced all of the factors (except illumination) involved. A selected bibliography is appended in the report.

The tests and measurements employed in this survey were physical, physiological, psychological and educational. The work comprised a study of the relationship between a complete analysis of ocular conditions and a large number of psychological and educational factors and also included the measurement and correction of Aniseikonia with the other ocular defects.

The collaborators in this work frankly and modestly state that: "Because of the many factors involved, certain regrettable errors and omissions occurred which might limit the value of the results attained," yet a review of their report discloses the great value of the work.

The subjects for the survey, composed of the Freshmen of the 1940 Class at Dartmouth College, afforded material of exceptional quality and enabled the investigators to make "repeat" tests and measurements for proper correlation.

The report comprises a description of the methods used in the survey and includes scholastic aptitude, reading tests, eye-movement photography, refraction, oculo-motor conditions, Aniseikonia, eyedness, handedness, ocular data and controls, eye-movement photography controls, psychological and educational methods.

The results of the survey are graphically given in text and by tables, and comprises a correlation of the data with respect to symptoms, frequency of ocular difficulty, relation between ocular defects and performance, relation of reading performance to academic achievement, results of ocular correction.

The summary states frankly the limitations and difficulties encountered but much factual data obtained is clearly stated in detail and is of immense value.

The "reviewer" has observed the unusual facilities placed at the disposal of this research group, is familiar with the commanding ability of the clinicians who assisted in the work and fully appreciates the open-minded, unbiased approach and planning which the collaborators gave to this work and which made this notable survey possible.

This comprehensive work should command the attention of all thoughtful optometrists. Howard C. Doane.

EDITORIAL NOTICE TO CONTRIBUTORS

The American Journal of Optometry is a monthly journal, published in annual volumes of about five hundred pages of reading matter each, illustrated where necessary, by cuts in the text.

About four-fifths of the space is devoted to original paper, and the remaining fifth is given over to technical editorials, abstracts and book reviews.

The papers and reports are original and are accepted only with the understanding that they are to be published in this journal exclusively.

The editors and publishers of the American Journal of Optometry beg to offer the following suggestions to authors who propose to favor them with the publication of their contributions.

I. Write on one side of the paper. Double-spaced, typewritten MS. is preferred.

II. Words to be printed in *italics* should be underscored once, in SMALL CAPS twice, and in LARGE CAPITALS three times. **Antique type** when called for should be so marked.

III. Be sure that the title of your paper indicates its contents. Should the subject be a general one, for instance, Case Reports, it would be well to mention the subject of each special report—for instance: Case One. Progressive Myopia with Exophoria. Case 2. Divergence Squint with Amblyopia. These special titles will appear in the table of contents of each number.

IV. Illustrations should be carefully drawn on separate sheets.

V. When authors receive proofs for revision, they should correct and return these without delay. We beg, however, to remind our contributors that changes in the manuscript necessitates resetting, this causing much additional expense, so we ask that alterations be limited to what is of essential importance.

VI. Because of the added cost, we have discontinued the giving of gratuitous reprints to our authors, but we will supply them with these at the cost of press work and paper where so desired. The following tables of charges will apply for the year 1938.

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